INFORMATION REPORT

CENTRAL INTELLIGENCE AGENCY

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The photographs listed below can be obtained from Graphics Register by CIA Photo accession number. The text concerns technical innovations and reforms in the iron and steel industry including the Chicom-developed top blown oxygen furnace method at Shih-ching-shan Iron and Steel Plant and the fuel injection method of the blast furnace at An-shan. Also included is information on improved products such as stainless steel, cold rolled plates, and low alloy steels. The texts are unedited translations of the publications cited above and are on file in the CIA Library. They are unclassified when detached from the report.

CIA Photo Accession No.:

1058460 — Shih-ching-shan Iron and Steel Plant (39 55N 116 09E) [redacted] 25X1
Ingot being poured into oxygen blow-up revolving furnace No. 1 at the new Oxygen Blow-Up Revolving Furnace Steel Mill, Pei-ching.

1077261 — Shang-hai Iron and Steel Plant No. 1 (31 21N 121 29E) [redacted] 25X1
Workers under the recently installed electric fans in the open hearth furnace shop. An anti-heat temperature lowering device was installed before summer.

1077254 — An-shan Iron and Steel Plant (41 08N 122 59E) [redacted] 25X1
Ash collection device installed in Sintering Shop No. 2. Device reduced the volume of ashes being discharged through the

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	CIA Photo Accession No.:	
		smokestack from 10,000-15,000mg per cubic meter to about 500mg per cubic meter.
	1077255	Heavy steel rails being processed by finishing department of Rolling Mill.
	1077252	On-the-job training in Pipe Casting Plant.
	1096408	New coking oven at #5 Coking Plant.
	1089121	New low alloy high strength steel produced by large Rolling Mill.
	1089120	Testing new steel making process in open hearth furnace.
	1086673	New Ore Dressing Plant at An-shan Iron & Steel Plant.
	824451	No. 3 Steel Plant of An-shan Iron and Steel Plant.
	848639	Large diameter seamless tubes mass produced at An-shan.
	979235	Alloy square steel for large bridges manufactured in the Large Rolling Mill.
	1160248	Seamless Tube Plant.
25X1	1096404	Fu-shun Chemical Plant (41 51N 123 53E) [redacted] New Coke oven [illegible].
25X1	940888	Wu-han Iron and Steel Plant (30 38N 114 27E) [redacted] Coal being fed in coke oven.
25X1	421762	Pao-tou Iron and Steel Plant (40 39N 109 48E) [redacted] Coke oven No. 3. This plant has 65 chambers and produces 450-500,000 tons per year.
	1150776	Hsin-feng (24 04N 114 12E) Hsin-feng Processing Plant Rolling bridge devised by workers which performs a continuous operation of joining hot rolling and cold rolling alloys alternately.
	1150777	Materials produced by medium temperature rolling of aluminum alloy.
	1095572	Shang-hai (31 14N 121 28E) Heat treatment of cold roll silicon steel by continuous furnace developed at the Shang-hai Iron and Steel Institute. The magnetic, insulating, voltage proofing characteristics of the cold roll silicon steel have equaled or surpassed those of western products.
25X1	1160245	Chung-ching Iron and Steel Plant (29 29N 105 30E) [redacted] Steel plates being loaded into freight cars for shipping.

Enclosures: As Stated Above

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PHOTOS AND FEATURES [illegible], [illegible]

RECENT IRON AND STEEL INDUSTRY IN COMMUNIST CHINA

Communist China started its third 5 year plan for the iron and steel industry after undergoing an adjustment period since 1961. The entire iron and steel industry in China has made advance in productivity, quality and types of products. The Peiping NCNA of 15 June reported that steel, steel materials and pig irons produced during January through May of 1966 far surpass those produced during the same period last year. The production of iron and steel during 1966 has improved each month and the types of steel materials totalling over 250 have been successfully test manufactured. Most of the test manufactured materials are of high temperature resisting, high pressure resisting and low pressure resisting materials. Among them are steel for high pressure receptacles, which can resist several hundred atmospheric pressure, needed for petroleum and chemical industries; high heat resisting materials for manufacture of internal combustion engines and turbines and low heat resisting materials for manufacture of large oxygen gas facilities. The production of large quantity of steel materials has made Communist China self sufficient and thus destroyed the blockade of China formed by imperialism and revisionism.

Anshan Iron and Steel Company

The quantity and quality of materials produced by the Anshan Iron and Steel Company [hereafter referred to as Anshan Steel] have greatly improved and the cost of production has been lowered considerably (NCNA 29 June 66). It is said that the amount of funds offered to the state by the Anshan Steel during the entire year of 1965 is equivalent to the amount required to build ninety chemical fertilizer plants of 100,000 ton capacity [per annum] (NCNA 28 April), but the amount of materials produced during the first five months of 1966 is enough to build 50,000 "Chieh-fang" brand trucks and the funds set aside for the State is equal to the amount needed for the construction of over 40 large size blast furnaces (NCNA 29 June). An average of 1.3 new product was produced each day during 1965 but the average has risen to 2.1 and the amount of new products test produced successfully during 1966 has already doubled from last year..

The [illegible] of steel materials during the first quarter of 1966 has gone 8% beyond the plans of the Anshan Steel and the production of steel ingots, cokes, fireproof materials and steel tubes has surpassed the target. An iron ore production is 15% greater for the same period of last year.

Anshan Steel produced over 5 million tons in 1959 after the basic construction of the company was completed. Steel ingot production reached 4 million tons. After the "adjustment period" from 1961 to 1965, improvement in facilities was made to further improve the production capacity.

During the "adjustment period", which began in 1961, an emphasis was placed on the source of raw materials. A construction of two Ta-ku-shan iron ore mines, an iron ore mine for open-hearth furnace and a magnesite mine was carried out. By 1963, twelve new mines including these given were established. Some new plants were included among the new construction which made possible to include products such as sheet metals.

During 1965, an iron ore crushing plant at Yen-ch'ien-shan iron ore mine, sintering and sifting facilities at Tung-an-shan Sintering Plant, an acid-alkali wash shop and a large oxygen station were completed. The completion of these facilities has a great significance. For axample, a mechanized ore crusher is capable of crushing 60 tons of ores in two minutes which improves the production capability. The oxygen maker at the oxygen station is able to separate oxygen from nitrogen by freezing the air at -170° C. In other words, a basic condition required for the open hearth oxygen method of steel making has been established at the Anshan Steel.

Furthermore, the Anshan Steel used the most modern techniques in renovating the large blast furnaces No.4, No.7, No.9 and No. 10 during 1965. Instead of lining the bottom of each blast furnace with fire-bricks, high heat resisting- corrosion resisting carbon bricks were used and the sides were fitted with cooling linings. New automatic detecters to detect corrosion and burning through have been installed at the bottoms of these furnaces. Hot-air furnaces, which have a direct bearing on the production increase of blast furnaces and on the consumption of cokes, have also undergone renovation with modern techniques. The results have been great. For axample, the hot-air temperature at No.9 blast furnace after the renovation has been increased to 1230° C.

Many new techniques and facilities have been introduced at the Anshan Steel. A new rolling technique used a[illegible] ...ry increased the production capacity by 20% (NCNA 10 April 1966). The water cooling method used in heating furnace, open hearth furnace and blast furnace is being replaced by a vaporization cooling system. It is calculated that if the entire furnaces in Anshan Steel were to be converted to the vaporization system, a saving of 110,000 tons of coal each year, and a reduction of 19 boilers and 104 boilermen can be realized. The steam produced by the vaporization cooling method is used in manufacturing processes and in homes. At the present time, all open hearth furnaces, part of the small and medium size rolling furnaces at the Anshan Steel have been converted to the vaporization method. test on use of this system on blade opening of blast furnace has been generally completed. A conversion to the vaporization system can be done quite reasonably and the results are good. The entire expenses can be recovered in a short time and the life of the cooling facilities can be extended. At the same time, the quality of products has been improved. The Anshan Steel is also conducting tests on the use of hot air blowing instead of a gas in sintering, on production of certain steel alloys, which were formerly produced only by an electric furnace, through an open hearth furnace, on development of new techniques to consolidate 8 processes used in steel tube casting plant into a single operation and on development of a dry magnetic ore separating plant (NCNA 2? April 1966).

Chungking Iron and St l Company

There has been comparatively many news on Chungking Iron and Steel

Company (hereafter referred to as the Company), which indicates that the Company produced results worthy of special mentioning. The NCNA of 3 May reported that Company produced 32 new steel products during the first quarter of 1966. The new products include alloy structure steel plates and seamless alloy steel tubes for petroleum cracking facilities, various hot rolled steels, superior grade steel materials, special type steel pipes and special steel plates which were not produced in Communist China. The Company not only succeeded in test manufacture of two new types of alloy structure steel plates for KURAMAI [phonetic] oil fields in Sinkiang, but also new materials vital to the manufacture of turbines and also for coal gas blowing facilities used in metallurgical, chemical and mining industries. The mass production of the new steel materials solved the urgent need for coal gas blowing facilities at 17 industries and enterprises throughout the country. The Company also started on a mass production of steel materials for agricultural use from this year. Those materials include steel plates, die steel and seamless steel tubes for various agricultural machineries and equipment. After realizing the value of hexagonal steel bars for excavation of mountains and for drilling in building farms, a positive improvement in operation was made.

The Company carried out a basic construction on a large scale to prepare for production during the "adjustment period." The Company started on 10 projects to be completed by the third quarter of 196[illegible]. Included in these projects are: (1) construction of new type coke secondary product recovery plant, ( ) expansion of portion [illegible] fications and types of steel for agricultural use, (3) expansion of seamless tube plant to include production of over twenty types of smaller tubes, (4) technical improvement of essential facilities for excavation, ore dressing, crushing and processing at Ch'i-chiang Iron Mine and (5) expansion of limestone and dolomite mines. It was also reported that an 8,000 ton annual capacity ammonium sulphate plate [illegible] plant were completed in December of 1963. According to a Chinese newspaper of 9 November 1964, the first phase of the technical reforms in small and medium size rolling plants has been completed at the Company and the production of steel per hour has been increased by 10%. Furthermore, the mass production and quality improvement of more complicated special steel materials (sheet steel, T -steel, I-steel, square steel, channel steel), which required difficult manufacturing processes, were made possible.

Shih-ching-shan Iron and Steel Company

Since the "adjustment period", the Shih-ching-shan Iron and Steel Company in Peiping [hereafter referred to as the Company] has been making a steady progress. It is noted that this Company expanded the converter steel making plant using the oxygen "upper blowing [literal translation]" steel making process, which has never been used in Communist China up to this time, in early part of 1965. This oxygen blowing method is a new metallurgical technique even internationally. The facilities at the Company were designed, manufactured and installed completely by the Chinese themselves.

During 1958 through 1960, the Company put No.3 blast furnace , No.3 coke oven and sintering plant into operation. The old No.1 blast furnace of 1920 European type and the No.2 blast furnace of old Japanese type were completely converted and modernized. The No.3 Blast furnace, which was copied from a foreign type, had a top charging opening for 20 tons and had to be replaced each year. The charging opening was strengthened in 1963 and is now able to handle over 1 million tons of ores and cokes each year and the opening which has been used for over two years is still intact.

The Company eliminated the danger of an explosion and succeeded in continues blowing of pulverized coal in blast furnaces during the year of 1965. The blowing has reached 30% of the total fuel load of the furnace. It is said that this pulverized coal blowing technique. has not been fully accomplished by other advanced nations. The success achieved in China indicates the top technical level China achieved in the metallurgical industry. The Company has achieved injection of pulverized anthracite coal amounting to [illegible] of the total fuel used and created combustion with cokes in the ingot steel process without causing hindrance to the normal operation of the blast furnace and without loss of heat. The Company started the test on this injection technique during the summer of 1963. During the test, spontaneous combustion occurred twice and a minor explosion occurred to cause injury to some personnel. Scientists and designers arrived from Shanghai, Hang-chou and Nanking and carried various resear-

PHOTOS AND FEATURES OF CHINESE INDUSTRY, 15 April 1966

NOTEWORTHY RESULTS OBTAINED BY CHINESE IRON AND STEEL INDUSTRY

ORDINARY LOW ALLOY STEEL

China succeeded in refining a world's latest "ordinary low alloy steel", which will be further developed during the third 5 year plan.

This new type of steel refined from ores of various metal paragenesis produced abundantly in China will probably replace the traditional carbon steel, which holds the top position in modern iron and steel industry of the world. Most of the countries still uses carbon steel in most of the machineries, transportation equipment and construction materials and alloy steel is used in small number of products requiring special precision and quality. The world's carbon steel production is around 90% of the entire steel production. China has been following the same pattern; however, the heavier, more breakable, more susceptible to corrosion and less durable carbon steel does not meet the demand of the Chinese people's economic development. Therefore, they decided to break away from the "western sphere of influence" and started on a great revolution of the Chinese iron and steel industry. The new "ordinary low alloy steel" is the product of this revolution.

A. 14 Types Being Refined and Many Others Being Test Manufactured

According to the Peiping NCNA of 9 February, China has succeeded in refining 14 different types of ordinary low alloy steel and tens of new types are being tested. It states that these new steel can be refined in an [illegible] using an ordinary method. The production method is more simple than the method used for special steel. Furthermore, the cost of production is cheaper, the production scale can be large and the usage is as great as the carbon steel, but superior in strength, performance, anti-corrosion, warability and longevity. The products made out of ordinary low alloy steel outlast products of carbon steel by 30 to 100%. In some cases, this low alloy steel can be substituted for nickel-chrome alloy steel.

A large use of ordinary low alloy steel in China during the past few years not only revolutionised the steel products but also provided an advantageous condition in revolutionising the other economic areas. For example, bridges are now being constructed out of ordinary low alloy steel and are welded instead of being riveted. The use of this new material cut down the weight and material and simplified the construction work and increased the life expectancy. The use of new steel in a production of high pressure container set capable of producing 50,000 tons of synthetic ammonia a year, cut the weight of each set by 40%, reduce the operating time by about 40% and lower the cost of production proportionately. Over 100,000,000 tons of freight were transported over rails made of low alloy steel but showed little wear and the life expectancy of these rails is estimated to be two to three times longer. A television tower in Canton is 200 meters high and is built out of low alloy steel which resulted in the saving of 20% in materials.

In addition, ordinary low alloy steel is being used in transportation, machineries, chemistry, petroleum and buildings. It is said that the quality of locomotives and other rolling stocks, ocean going vessels, automobiles, tractors,

pressurized containers, power station facilities and large scale construction
materials is very good.

B. Use of Paragenetic Metal Ores Expands

There is great promise in use of ordinary low alloy steel in China. The
NCNA of 9 Febru[illegible] " A large quantity of various types of metal parage-
nesis ores and alloying resources were discovered and are being developed. This
will provide an abundant supply for the future large scale development of ordi-
nary low alloy steel."

In regards to various paragensis ores of China, a foreign metallurgist once
said that these are complicated and hard to refine. However, the Chinese iron
and steel workers, while studying Mao's Works, understood the phrase "disadvan-
tageous elements can be changed to advantageous elements" and carried out re-
peated researches and tests while working and finally overcame the difficulty of
refining the paragenesis ores. A road opened by the Chinese to utilize fully the
abundant paragenesis ore resources is highly appraised as bringing about an advan-
tageous condition in promoting "greater, faster and more splendid" development of
iron and steel industry of China, in establishing China's own series of iron and
steel products and in increasing or even surpassing the world standard in types
and quality of steel products.

C. Over 170 Steel Materials at Anshan Steel Company

Anshan Steel Company, a largest steel mill in China, has shown especially
good results in the refining of low alloy steel. During 1965, Anshan Steel

Company designed and produced over 400 new steel materials. Of these, 170 are strong new materials made out of low alloys. These new low alloy steel materials are refined by mixing alloying elements, such as silicon, manganese, boron, and rare earth into an ordinary carbon steel. An addition of alloying elements causes change in chemical composition which strengthens ordinary carbon steel into materials of low and high temperature resisting, wear resisting and shock resisting characteristics and said to have a better welding quality.

A medium plates plant of Anshan Steel Company successfully test manufactured low alloy steel plates of 3mm thickness for automobile chassis frames. These will replace the 6mm carbon steel used in chassis of small jeeps. The reduction in weight affects the loading capacity and cut down on the cost. The workers at a large rolling mill succeeded in test manufacture of strong low alloy channel steel in August [1965] to be used for chassis in "Hung-ch'i" 100 type tractors because frames buil.. ~ut of carbon steel often twist after a long use and do not have the pulling power. The new alloy steel increased the pulling strength by 37%. Steel plates, L-type steel, square steel and channel steel of low alloy steel for bridges are being manufactured by a rolling mill and a medium size rolling mill of the Anshan Steel Company. The use of these new materials cuts down on the construction time and reduce the weight by 19%.

It is said that the number of types of alloy [illegible] and low alloy steel produced during January to November of 1965 doubled that of 1960 at the Anshan Steel Company. During the first 5 year plan (1953- 1957), the Anshan Steel Company produced only a little amount of alloy steel with an open hearth furnace, but the workers responded to the demand of people's economic development, devised and expanded the use of an open hearth furnace in the manufacture of alloy steel during the past few years. The use of a large open hearth furnace is much more economical than the electric furnace in the refining of alloy steel, but the control of heat and chemical composition of alloy steel is relatively more difficult in an open hearth furnace. However, the workers through assistance of engineers from the Institute of Iron and Steel learned new techniques and succeeded after many experiments. They overcame the difficulties, started mass production and continue to improve the quality.

The Anshan Steel Company also succeeded in test manufacture of pressure hardening equipment, a facility for production of alloy steel plates. A hardening process used in the production of ordinary low alloy steel plates is to improve the strength, tenacity, ductility and impact force. In the past, the Anshan Steel Company used vats to harden ordinary low alloy steel manually, but this method requires great manpower and the quality of the steel paltes cannot be guaranteed. The new pressure hardening machine operated by push buttons automatically bring heated ordinary low alloy steel plates into the machine, applies 100 tons of pressure with over 1000 horse hoof shaped pressing devices and temper the plates with water shooting out evenly and suddenly from over 20,000 apertures. Engineers who designed the machine, are all young men of the Design Department of the Anshan Steel Company. Since these men were newly hired and lacked experience, they toured around over ten shops including rolling and repair shops. A first design of the pressure hardening machine was nearly completed after three months of research and study and finally succeeded after receiving cooperation of the concerned specialists and after repeated tests and renovations.

D. Ordinary Lew Alley Cupriferous Steel at Wuhan Steel Co.

Wuhan Steel Company is now mass preducing ordinary lew alley cupriferous steel with a large open hearth furnace. A principal ore bed of this company has iron eres with relatively high copper content. The success in refining this cupriferous eres epened a way to utilize a large resource of cupriferous iron eres existing in China. Steel of this preduct is stronger, has better plasticity, corresion resisting and has longer life expectancy and considered good for bridges, ships, relling stocks and agricultural machineries. These steel materials are new being used in railroads, petroleum industry and machineries.

PH OTOS AND FEATURES OF CHINESE INDUSTRY, No. 59, 1 Jan 66

1965 RESULTS OF COMMUNIST CHINA'S STEEL INDUSTRY

A. 500 New Products Successfully Test Manufactured

Communist China attained great results in steel industry during 1965. According to Peiping NCNA despatch, Communist China achieved their production goal for steel, pig iron, steel materials, cokes and iron ores one month ahead of schedule, and also succeeded in test manufacture of over 500 new steel products needed by the country.

Communist China's goal is to become self sufficient in steel products soon; therefore, they have been carrying out test manufacture of steel products. During the past year, they succeeded in manufacture of stainless and other high grade steel alloys having special heat resisting, high pressure resisting, rot resisting and warp resisting characteristics. Some of the steel products of last year include thick plates for high pressure boiler used in 5,000 to 10,000 ton nitrogen fertiliser facilities, light weight channel steel for manufacture of new type tractors, cold rolled thick plates, deep drawing use cold rolled steel plates, new type propeller shaft steel tube of tough and durable quality for automobile industry, "concave" type spring flat steel, special steel alloy thick plates for petroleum cracking facilities, thin steel tubes, steel pipes for boring oil well beyond 3,000 meters, spiral type oil radiator, and extra low carbon stainless steel for vinylon manufacturing facilities. The increase in pig iron production greatly improved the ratio of self sufficiency in steel materials which improved the condition for the realization of their third 5 year plan starting in 1966.

The workers of steel industry improved the quality of their products and in the case of an open hearth steel, the quality is all first class and the second class was eliminated.

They have also achieved great results in the adoption and development of new techniques. The NCNA of 22 December stated that "the advanced upward oxygen injecting technique in converters and various injecting techniques in blast furnaces are now being applied in production. The sheet rolling mill lifts of Shanghai No. 3 Steel Plant are being widely propagated through other rolling mills in China. The coal blended coke technique developed in China is being adopted in various coke plants. These new techniques formed a technical foundation for faster and better development in iron and steel industries of China."

B. Over 400 New Products at Anshan Steel Company

The Anshan Steel Company, a largest steel plant in China, designed and produced over 400 new steel materials used for agricultural machines, petroleum and chemical industries, automobile industry, light industry and for newly rising industries. In addition, high strength steel tube for oil drilling, steel plates for high pressure container of 300 atmospheric pressure, seamless tube of 1mm thick, steel plates for 10,000 ton ocean going vessels, and materials for tractors and automobiles. The company also produces in large quantity steel of various sizes and shapes.

Most significant achievement of this company was the success in test manufacture of over 170 types of low alloy high strength steel. This type of steel is highly regarded by all advanced nations. In the manufacture of this steel, a small amount of alloying element such as silicon, manganese, boron and rare earth are added into an ordinary carbon steel. The chemical reaction caused by adding there elements strengthens the ordinary carbon steel to withstand low and high temperature, wear and shock and improves the welding characteristics. The cost of manufacturing is reduced because of the small quantity of alloying element used. It has been estimated that the cost of commodities and facilities can be reduced by about 20%.

Communist China has been using 6mm ordinary carbon steel plates in chassis and frames of small size jeeps, but has been changed to 3mm plates developed by the Anshan Steel Company. The reduction in thickness increases the loading capacity, decrease the weight of vehicles and also the cost of production.

It is said that the use of low alloy high strength channel steel manufactured successfully by the Anshan Steel in August 1965 in chassis and frames of tractors increases the pulling power by 37%. It was discovered that the twisting of chassis and frames of "Hung-ch'i" tractors after long use was due to inadequate strength of steel used; therefore, the workers of the plant came up with this new steel material.

The steel plate and rolling mill and the medium size rolling mill of the Anshan Steel Company are manufacturing low alloy high strength steel plates, I steel, square steel and channel steel for bridges. It is claimed that the weight of bridges has been reduced by 19%.

The production of this low alloy high strength steel is small in relation to production of other steel materials but the workers at Anshan Steel will continue their efforts in conducting researches, increase commodities and expand production for the people's economic development.

C. Improvement of Basic Structures and Blast Furnace at Anshan Steel

Another noticeable accomplishment of the Anshan Steel Company is the completion of plants for course crushing of iron ores, sintering, sifting, rolling, "acid-alkali bath" and large oxygen station. These plants are now in production.

The iron ore crushing plant is located at Yen-ch'ien Shan iron ore mine. Prior to the construction of this plant, workers used to crush ores with [sledge] hammers, but the plant is capable of crushing 60 tons of ores in two minutes which will increase the production many folds .

Sintering and sifting plant was completed at East Anshan Sintering Plant which indicates that better quality material will be fed into the production of steel materials.

The newly constructed acid-alkali bath will remove rusts and other blemishes from the surface of steel materials to improve the quality of steel products.

A large oxygen manufacturing machine installed at oxygen station converts liquified air to below 170° and later resolve oxygen and nitrogen. This station was established to promote development of open hearth oxygen steel making techniques.

Designing and manufacturing of f[illegible]ilities for above plants were [illegible] carried out domestically by the Chinese work[illegible].

In addition to above, the Anshan Steel Company has [illegible] [illegible] the blast furnaces No.4, No. 7, No.9 [illegible] No. 10 under the most modern [illegible]

Out of the four renovated furnaces, No. 10 was built by the Chinese but the other three were left behind by the Japanese and was considered not able to comply with the demands of technical development. However, renovation combined with overhauling was carried out last year. The bottoms of blast furnaces are lined with high temperature resisting and anti-erosion carbon bricks instead of fire-proof bricks and the entire sides have been lined with cooling liners. The bottoms are equipped with most modern automatic checking devices which detect erosion by water at the bottom to insure safe production. It is said that the renovation [illegible]ased the life of these furnaces by at least 25%.

A hot blast furnace, which has a direct relations in production increase and in decrease of coke consumption of the blast furnaces, had been renovated to utilise modern techniques. The No. 9 furnace is now able to produce 1230° C compared to around 1000° C prior to renovation. It is said that such high temperature is rarely seen in steel industry of the world. The increase in blast temperature results in saving of about 40kg of cokes for every ton of ores refined and the production has increased by 8%.

All fire resisting materials, electrical and mechanical equipment used in the renovation of blast furnaces were made domestically by the Chinese. Engineers of Chungking and Anshan Ferrous Metallurgical Designing Academies, who carried out the renovation work, not only acquired modern technical experiences but succeeded in introducing technical reforms to many blast furnace workers of China.

D. Chungking Steel Company Produced 42 New Steel Products

The Chungking Steel Company also produced great results during 1955.

The company succeeded in producing 42 new steel products including composite stainless steel plates used in manufacture of facilities for chemical and petroleum industries. Small channel steel, I steel, medium concave type flat steel for manufacture of parts for agricultural equipment, such as tractors and combines, and props for mines are also being produced.

The composite stainless manufactured successfully have the anti-corrosion characteristics of the alloy steel and the merits of the carbon steel. The Manufacture of composite stainless not only economize the use of nickel and chrome but cost much less than the ordinary stainless steel plates. Technical aspects and rolling techniques used in the manufacture of curved steel material for mines were very difficult, but the designers worked together with the plant workers and overcame the difficulties. The company succeeded in rolling 42 new products within the one year period and these new products will go into mass production from 1966.

In addition, the Chungking Steel Company maintains a top position in the production of steel plates for ship building and boilers. Steel plates from this plant are shipped directly to "several tens" boiler plants and ship yards. During the past year (1965), the acceptance rate of plates for boilers went up to 99.8% and the plates for ships rose to 99.86%, which shows an improvement of 0.16% and .11% respectively over the rate at the beginning of the year.

E. Special Results Obtained by Metallurgical Industries in Peiping

The metallurgical industry in Peiping [illegible]

metallurgy, rare earth nodular graphite cast iron products and precision [illegible] wires for instruments and guages.

Peiping area is making a rapid development in powder metallurgy. Over 300 new poducts are produced. These include iron, copper, molybderum, tungsten and nickel powders pressed into various bearing metals, machine parts, filters, electronic and refrigeration elements and into hard metals, such as diamond metallurgical tools, ferrite materials and "hard to melt" metals. These products are being widely used in automobiles, tractors, textile machineries, agricultural equipment and measuring instruments. The oil-less bearing metal of iron powder metallurgy produced last year by the Peiping T'ien-ch'iao Powder Metallugical Plant is now being used in manufacture of close to 100 types and specifications. Over 900,000 pieces have been produced. The production of this type alone saved 250 tons of bronze last year [presumably by the plant]. In the past, parts for scrapers and pumps manufactured by Peiping No.1 General Use Machines Plant were first cast the bronze and then machined but has changed to powder metallurgy. The quality of the compressed copper powder meets the specifications and the first production of 30,000 parts has already saved 10.8 tons of bronze, 33,000 man hours and about 25 milling machines.

The nodular graphite cast iron produced in Peiping is known for its long life. This type of cast iron produced by adding rare earth elements is used for roller at rolling mills, bearing metals for locomotives, crank axles for automobiles and parts for machineries used in agriculture, textile, chemical industry and medical equipment.

A rare earth high sil on heat resisting grinder studied and test manufactured jointly by the repair and assembly plant of the Peiping Electric Train

Company and the Ch'ing-hua University showed no signs of wear or scratches even after using it for over 50 times. A heat resisting grinder of high carbon steel would require a replacement after 20 uses. The cast iron roller processed with rare earth elements by the Peiping Roller Plant has three times the life of a roller of magnesium cast iron roll and twice the life of a cast steel roll.

A spheroidising agent is used in the manufacture of nodular graphite cast iron, but the use of magnesium created high rate of rejects because the cast materials from this type of cast iron often had defects of some sort. Furthermore, magnesium powder put into a boiling water causes a violent heat radiation and a cloud of dust and smoke which can be detrimental to workers' health. However, the use of rare earth elements (commonly known for 15 lanthanium types given in periodic table of Mendelev [phonetic] element and yttrium and scandium) as spheroidising agent removed most of the above problems.

The Peiping Steel Thread Plant succeeded in producing electric resistance parts of iron, chrome and aluminum for remote control and remote measuring. The product is almost invisible to the naked eyes but possess a high electric resistance rate and is very sensitive. This is also used in measuring devices, medical facilities and communication devices. Not too many countries are able to produce such a fine product.

The Peiping Steel Thread Plant ~~is~~ made up of former 16 rope factories started to contribute toward meeting the demand of the nation in 1958 and succeeded in the manufacture of iron-chrome-aluminum product in 1961. The plant test manufactured 112 items during 1965.

Part II, No. 50

Recent Technical Reforms in Communist China's Iron and Steel Industry

Communist China's iron and steel industry is again attaining steady results this year. Iron and steel production figures have not been announced since 1961 and they were not announced this year but, according to a NCNA cable from Peking dated 23 July, over 280 varieties of new steel materials were successfully trial manufactured by the various iron and steel enterprises during the first half of this year (January through the end of June). The Chicom iron and steel industry has been exerting its utmost efforts in recent years on diversification and the trial manufacturing of new iron and steel products. Accordingly, her self-sufficiency rate in steel materials is rising steadily. The steel materials successfully trial manufactured this year included over 30 varieties of special performance steel materials needed for chemical fiber manufacturing plants; cold strip steel sheets, wide cold-strip steel sheets and [illegible] steel tube needed for manufacturing new model automobiles [illegible]; oil [illegible] pipe needed to dig over 3,000-meter deep oil wells; 12[illegible] mm thick high pressure steel plates needed for large nitrogenous fertilizer equipment and large power generation equipment; and steel materials requiring complex and advanced techniques. These steel materials [illegible] Communist China's self-sufficiency rate a step higher than [illegible] self-sufficiency rate of 95 percent.

The An-shan Iron and Steel Corporation, which is the largest iron and steel enterprise in Communist China, exceeded its production [illegible] steel materials, steel ingots and pig iron for [illegible] Calculating in terms of average production standard, [illegible] increases for this corporation compared to its production [illegible] 4th quarter of last year was 8.8% in steel materials, 9.6% [illegible] and 16.2% in pig iron.

The above results cannot be separated from the recent technical reforms being rigorously advanced in Communist China's iron and steel industry. These technical reforms are not limited to the iron and steel industry. Taking the form of a mass movement, they are being conducted [illegible] scale in various areas of production including [illegible] to compare, learn, overtake and support. During the [illegible] example, the workers of the An-shan Iron and Steel Corporation [illegible] over 10,000 technical reforms and technical revolution proposals [illegible] of them were implemented. The Wuhan Iron and Steel Corporation, which is the second largest iron and steel combine in Communist China, [illegible] implemented over 250 reforms to increase the daily production of its [illegible] furnaces 5-10 percent and to more than double the life [illegible] open-hearth furnaces. These technical reforms [illegible] extensively in all the other iron and steel [illegible] The major and vital technical reforms that [illegible] production in Communist China are as follows:

Adoption of Fuel Injection by the Plast Furnaces of the An-shan Iron and Steel Corporation

According to a NCNA An-shan cable dated 18 July, the various blast furnaces of the An-shan Iron and Steel Corporation have been employing a new fuel injection technique since April of this year. Coke is the principal fuel being used by the blast furnaces for smelting pig iron. Since the injection of liquid or gaseous fuel would result in huge savings of coke and raise the production capacity of the blast furnaces, the nations throughout the world possessing highly developed iron and steel industries are extremely interested in this new technique. Various types of fuel can be injected into the blast furnaces i.e., heavy oil, natural gas, coal dust or a mixture of coal dust and heavy oil; the fuels being used by the An-shan Iron and Steel Corporation are heavy oil and tar oil.

In 1963, the An-shan Iron and Steel Corporation began testing and experimenting with the new techniques in fuel injection. It began injecting heavy oil in Blast Furnace No. 1, trial injecting tar oil in Blast Furnace No. 2 soon thereafter, and succeeded in both attempts. On the basis of these experiences, the An-shan Iron and Steel Corporation mobilized its workers and dispatched them to neighboring iron and steel enterprises to propagate the use of fuel injection in blast furnaces.

The adoption of fuel injection has resulted in a huge decrease in the consumption of coke at the An-shan Iron and Steel Corporation. According to calculations, of the various factors contributing to the decrease in the consumption of coke, fuel injection accounts for about 40 percent. The decrease in the consumption of coke reportedly saves 170,000 tons of coke per year and lowers operating costs more than 4,000,000 yuan (about 600,000,000 yen). Since the sulphur content of heavy oil and tar oil is less than the sulphur content of coke, the sulphur content of the pig iron is reduced substantially, resulting in an overall improvement in the quality of the steel. Fuel injection is also extremely profitable because it equalizes the temperature within the blast furnace, improves the technical conditions for the operation of the blast furnace, prolongs the life expectancy of the furnaces, produces good quality products and guarantees security.

Installation of a Simple Steam Collection Device at the An-shan Iron and Steel Corporation

In February of this year, a simple steam collection device was installed on one of the bloom heating furnaces of the medium-size rolling mill of the An-shan Iron and Steel Corporation. This device is capable of collecting four tons of steam per hour. This steam attains a pressure of 3.5 times atmospheric pressure, which is sufficient to satisfy all the needs of the mill including the coal gas producer, the steel material acid tank, the mess hall and room heating.

The thermal energy dissipated monthly by the 7-unit cooling water pipes of the two bloom heating furnaces of the medium-size rolling mill of the An-shan Iron and Steel Corporation is equivalent to the thermal capacity generated by over 1,000 tons of coal. Noting the steam being dissipated from the cooling water flowing out from the bloom heating furnaces, the workers began giving thought to a method for collecting and utilizing this untapped source of energy. After a series of experiments by the workers, technicians and cadre of this medium-size rolling mill, they successfully drafted a blueprint for this simple steam collection device during the first quarter of last year. They were aided in this technical reform by funds and technicians provided by the leaders of the An-shan Iron and Steel Corporation. Finally, in February of this year, after a 5-month effort, this steam collection device was installed on one of the bloom heating furnaces.

The technique of collecting the steam from the cooling system of the bloom heating furnace, which is commonly referred to as "vapor cooling", is a new technique that began appearing throughout the world this past ten-odd years ago. A number of industrially developed countries are extremely interested in this technique becasue it permits the collection and use of this huge volume of wasted steam for production and livelihood needs; it also curtails the need for special steam generation equipment and manpower. The successful adaptation of "vapor cooling" by the medium size rolling mill of the An-shan Iron and Steel Corporation is being noted with interest becasue it heralds the adoption of this new technique by Communist China.

According to the officers and cadre of this medium size rolling mill, the merits of steam collection are as follows:

1. Huge savings in auxiliary equipment and maintenance costs. By collecting steam from the bloom heating furnace, this rolling mill has been able to suspend the operation of its two steam generation boilers; preparations are under way to divert them elsewhere. By adopting vapor cooling for the other bloom heating furnace, this rolling mill will be able to eliminate its entire cooling water heat radiation equipment - water tower, reservoir, pump and cold water stand. Thus, in the construction of rolling mills hereafter, invaluable experience has been gained whereby there will be little or no need to construct steam boilers and no need to construct cooling water heat radiation equipment.

2. Savings in manpower, water, coal and electric power. After implementing vapor cooling, this rolling mill realized savings consisting of 15 workers, and over 800,000 tons of water and 5,000 tons of high-grade coal per year.

3. Steam collection is beneficial for extending the life of the equipment for cooling bloom heating furnaces and for raising the quality of steel materials.

Moreover, from the experiences of this medium size rolling mill, the technical aspects of this vapor cooling equipment is not very complicated, it does not require a large investment, its construction period is short, it does not require special materials and its total investments can be recovered in an extremely short period. This medium size rolling mill recovered its total investments of 33,000 yuan (about 5,000,000 yen) in merely two months and is beginning to show a profit of 25,000 yuan (3,750,000 yen) per month.

The medium-size steel sheet plant, the small-size rolling mill, the pipe welding plant, etc. of the An-shan Iron and Steel Corporation are actively engaged in the implementation of this new technique. Some are designing fixtures and some are already in operation.

<u>An-shan Iron and Steel Corporation's Resintered Ore Measuring Instrument and Hydraulic Spinner for Dressing Ore</u>

Extremely noteworthy are the An-shan Iron and Steel Corporation's two major innovations to raise the quality of sintered ore and dressed ore.

The innovation for raising the quality of sintered ore, called the "resintered ore measuring instrument", is a measuring instrument which was successfully manufactured by YANG Kuei-hua, senior gas engineer of Sintering Shop No. 2 of the General Sintering Plant of the An-shan Iron and Steel Corporation.

In the process of producing sintered ore, small granules of ore are produced which must be sintered again before they are usable. They are called "resintered ore" in Communist China. Heretofore, the General Sintering Plant of the An-shan Iron and Steel Corporation did not possess the equipment for measuring resintered ore. Accordingly, the quality of the sintered ore was affected because they could not gage accurately the amount of ore to be resintered. The ideal method for resolving this problem was to equip the plant with a resintered ore measuring instrument but Communist China had never manufactured equipment of this nature before and the Chicom technicians had checked through foreign technical data but they were unable to find an appropriate method. Making up his mind to construct an appropriate instrument through his own efforts, and obtaining hints from round HINICHI (phonetic) calculators, etc., YANG conducted a series of experiments and, finally, after six experiments supported by the party organization, plant cadre and plant workers, he succeeded in trial manufacturing this resintered ore measuring instrument.

Resintered ore measuring instruments are attached to four sintering machines of Sintering Shop No. 2 of the General Sintering Plant of the An-shan Iron and Steel Corporation at the present time. Fifteen months of actual production verify the fact that these measuring instruments have stabilized and raised the quality of sintered ore to a mark[illegible] degree The quality of Sintering Shop No. 2's sintered ore was raised from about 95% acceptable to over 99% acceptable during the past several year[illegible] and in April and May of this year, it attained the all-time high of 100% acceptable.

The quality of the An-shan Iron and Steel Corporations's ore dressing was raised appreciable due to the introduction of the hydraulic spinner.

The machinery being commonly used for dressing ore in Communist China at the present time is the spiral separator. The crushed ore is passed through the separator and the finely ground ore granules are selected for smeltering. But this machinery weighs as much as 46 tons, its structure is huge and bulky, and it is relatively inefficient.

The hydraulic spinner, a type of centrifugal separator, had been used heretofore by Chicom iron ore and coal dressing plants exclusively as a water and dirt remover but, internationally, it had been attaining favorable results as an ore dressing separator. With the support of related scientific research units, the An-shan Iron and Steel Corporation had been conducting years of experimenation and research on the use of the hydraulic spinner as [illegible] separator and, recently, it had mastered the required techniques.

By replacing the spiral separator with the hydraulic spinner, the An-shan Iron and Steel Corporation has been able to improve the granular size of its ore dressing and to raise its separation efficiency about 9%. This hydraulic spinner weighs merely one ton, its structure is simple and one hydraulic spinner represents a saving of 80,000 KWH of electric power per year. Moreover, this vital innovation is available to all the ore dressing plants throughout Communist China.

According to an article by HO Cheng-p'ing in the Jen-min Jih-pao dated 16 August, the East An-shan Steel Mill has improved its hematite flotation process and made a hugh contribution to greater production by lowering its daily losses in refined ore granules from over 50 tons to about 8 tons. Moreover, it has contributed greatly to the development of hematite flotation techniques in Communist China.

Whether the hydraulic spinner method is or is not being employed is unknown.

<u>Overall Life of Open-Hearth Furnace No. 20 of the An-shan Iron and Steel Corporation</u>

The large Open-Hearth Furnace No. 20 (charge increased from 350 tons to 440 tons in April 1959) of Steel Mill No. 3 of the An-shan Iron and Steel Corporation has been operating its throat, front and rear walls and mouth continuously for 20 months to set an overall furnace-life record totaling 1,210 runs. This may also be called a major technical innovation.

Overall furnace life must include, in addition to the throat of the open-hearth furnace, its front and rear walls, its mouth, its sediment room and its regeneration room. From 9 September 1963, when Open-Hearth No. 20 was partially repaired and returned to service, through 8 May of this year, its technical and economic indices - fire-proof material, fuel consumption, coefficient of utilization, rate of operation, smelting time, etc. - have attained the top level among the similar type open-hearth furnaces in Communist China. For example, its coefficient of utilization (tons of steel manufactured in 24 hours per 1 m^2 furnace floor) rose to 9.26 tons, 1.29 tons higher than the previous period. It consumed 7.07 Kg of magnesium fire-proofing material per ton of manufactured steel, which is the lowest record in the consumption of magnesium fire-proofing material since the inception of this mill. The rate of operation rose to 92.7%, which is 2.95% higher than the previous period. Thus, during this period, this open-hearth furnace exceeded its production goal by over 35,100 tons of quality steel.

In length of continuous service and number of smelting runs, the record of this open-hearth furnace and its various components is unprecedented in the history of steel manufacturing in Communist China and unique in the history of steel manufacturing throughout the world. In the future development of the overall life of Chicom furnaces and their components, the experiences gained from Open-Hearth Furnace No. 20 are expected to be invaluable. For this reason, many of the workers from other open-hearth furnaces are being dispatched to Open-Hearth Furnace No. 20 to study its advanced techniques.

<u>Shih-ching-shan's Oxygen Blow-Up Steel Manufacturing Method, Etc.</u>

Another advanced and noteworthy steel manufacturing method is being employed at the newly added revolving furnace steel manufacturing plant of the Shih-ching-shan Iron and Steel Corporation. It is a new metallurgical technique called the revolving furnace oxygen blow-up steel manufacturing method. All the machinery for this plant was designed, manufactured and installed by Communist China herself. The construction of this plant represents new development in Communist China's metallurgical industry. It can be said that she has gained the experience to construct additional new and larger plants.

The successful trial-manufacture of a new surface cutter for smoothening out the surface irregularities on steel materials and castings by the Shen-yang Wireless Equipment and Materials Plant has made a noteworthy contribution to Communist China's steel materials processing techniques. Heretofore, Communist China had been removing the surface irregularities on her steel materials and castings with [illegible] chisels and electric grinders, resulting in excessive waste, low effici[illegible] guarantee [illegible] the quality of the workmanship. But this [illegible] coal gas or acetylene, makes it possible [illegible] remo[illegible] surface irregularities from various large steel materials and castings without effort, it is 20-odd times more efficient and it improves the quality of the finished product. This new surface cutter is being used on a trial basis in a number of plants affiliated with the An-shan Iron and Steel Corporation with favorable results.

The above represent the key technical innovations reportedly adopted by the Chicom iron and steel industry during this year. In conclusion, special mention must be made regarding the hugh efforts being employed and the major results being attained in the utilization of industrial waste by the three major industrial cities in Northeast China - An-shan, Fu-shun and Shen-yang. How toutilize, dispose of and convert industrial waste to profit is one of the major problems confronting industrial production and city construction. An-shan, Fu-shun and Shen-yang were typical of the initial Chicom cities to experience this problem. From last year, they began implementing as many as 205 major and minor projects dealing with the disposition and utilization of industrial waste including the construction of city sewage treatment facilities, city sewage water trunk lines for farm irrigation, drainage for polluted water from plants and mines; settling reservoirs, neutralizing reservoirs, recovery towers and dust removers for waste gases; brick and cement plants using waste matter as raw materials; and other recovery equipment. 83 of these projects have been completed in successive intervals and they are already in operation. In Shop No. 2 of the General Sintering Plant of the An-shan Iron and Steel Corporation, for example, close to 100 tons of fine ore is being recovered from soot daily.

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CHINA'S NEW MIXED COAL THEORY WHICH HAS MORE THAN DOUBLED COAL RESOURCES AS RAW MATERIAL FOR COKE

STAT

So-called coke which can be obtained with high-temperature carbonization of coal is for the most part used in the metallurgical industry. Especially, a great amount of coke is consumed in iron manufacture, and coke used for iron manufacture must have especially excellent quality and good quality raw materials are necessary. However, raw material coal of good quality is not produced everywhere, and recently there has been caution concerning its world-wide insufficiency. Even in China, coal deposits are abundant, but comparatively little coke coal has been prospected until now. Moreover, accompanying the rapid development of the metallurgical industry, demand for coke has daily increased, producing a stringency of raw material coal. However, in China the former mixed coal theory has been recently broken through, and various kinds of coal which until now have been considered to be unusable in coke carbonization have appeared on the scene and opened up a great future for the metallurgical industry and the coke industry.

Paot'ou Iron and Steel Company Which Hardly Used Local Coal

The Paot'ou Iron and Steel Company was built in 1957, and since beginning operation, it has hardly been able to use the abundant coal of Inner Mongolia for coke carbonization, its percentage being less than 10 percent and at times not exceeding 1 percent. Depending on the extent of change of quality in coal formation, there is coal from the very worst peat and brown coal to long-burning coal, gas coal, rich coal (hitan), coke coal, lean coal (sotan), poor coal, and anthracite coal. Among these, as raw material coal for coke are used the four kinds of gas coal, rich coal, coke coal, and lean coal. Gas coal is a kind of bituminous coal and contains comparatively much volatile matter, and when air is cut off and it is heated, a large amount of coal gas and chemical products are formed. However, since gas coal, at the time of carbonization, gives off a great amount of gas and contracts, very many slender longitudinal cracks are produced, and since the coke breaks easily, it is very unfavorable [illegible] iron manufacture. Rich coal is also a kind of bituminous coal, but its volatile matter is lower than gas coal, [illegible] when it has been heated, considerable colloidal body is formed, [illegible] property is strong. However, since the independently [illegible] coke has many lateral cracks, its strength is inferior, and it is small and breaks easily, this is also not ideal coke for use in smelting. The volatile matter of lean coal is very little and the colloidal body is [illegible] little, and lumps of the carbonized coke are large and cracks [illegible] few, but there is much coke powder and its [illegible] poor, and consequently, it cannot be used independently in [illegible] facture. Only coke coal is an ideal raw material coal which [illegible] produces colloidal body of good heat resistance, has high [illegible] the lumps of coke are large and uniform, cracks are few, and the strength and antiabrasive property are good. However, resources of it are not very great, and moreover, since it has great expansion pressure, when it is placed independently in coke ovens, it sometimes destroys [illegible] ovens. Consequently, coke is made by combining the above four kinds of coal at a suitable ratio.

In the experience of foreign countries, it has been considered up to now that coke coal has to be principally used in mixed coal, with at least 30 percent, and that a fixed ratio of rich coal, gas coal, and lean coal, cannot be freely changed, and this manner of thinking was taken over in China. And, in Inner Mongolia there has been much gas coal and rich coal, with very little coke coal and even less lean coal.

Since most raw material coal has been brought long distances from Shansi, Hopeh, and the Northeast, the source of supply has been unstable, the quality low, and the recovery rate of chemical products bad and cost high. Therefore, the Metallurgical Industry Department and the leadership of the Paot'ou Iron and Steel Company had formerly proposed to the coke plant establishment of coal supply sources in Inner Mongolia. However, some of the administration, leadership, and technicians of the coke plant were under the restraint of foreign experience and theory, and having had a fixed concept for a long time concerning Inner Mongolian coal, did not lend an ear to this opinion. Some of the technicians of the coke plant had a different opinion concerning this question, but did not succeed in shaking the forces of tradition.

Decision to [illegible] Coal in the Anti-Waste Movement

In the [illegible] increased production, economy movement which unfolded in [illegible] employee mass of the coke plant pointed

out that long-dista[illegible] transportation of coal is counter to the fund-
amental principle of rational utilization of national resources and is uneconomic. The mixed-coal rule of foreign countries asserts that if coke coal is not principally combined in coke coal, good quality coke cannot be made. This rule was largely produced and formulated in countries of abundant coke coal resources and is suited to their specific conditions, and by means of it, coke of good quality and low price is manufactured. However, in countries of not very abundant coke coal resources, the cost becomes high, the production amount is limited, and without fully utilizing China's coal resources, development of China's iron and steel industry is hindered. In China, based on the status of China's coal resources situation, there had to be a mixed-coal rule which corresponded to the characteristics of resources of various places. However, for this, revolution was necessary, and first of all the old restriction of foreign theory had to be broken through. The leadership and technicians of the coke [illegible] became enlightened through studying philosophy, and breaking through the restrictions of foreign theory and setting out from the actual situation in China, they strengthened their resolve to seek out a new path for solving the problem of coal used for coke by means of research and scientific experimentation.

Breaking Through Existing Theory and Increasing the Percentage of Rich Coal and Gas Coal

In the latter part of 1963, technicians, production management, and supply purchasing personnel of the Paot'ou Iron and Steel Company and the Anshan Coke and Refractory Materials Design and Research Institute investigated in detail several coal mines of the Inner Mongolian Autonomous Region, such as the Shihkuaitzu, Laoshihtan, Niaota, and Yangkoleng coal mines. When they returned, they immediately began research, determining properties of the various kinds of samples and obtaining various data, for example, strength and antiabrasive property, thickness of the colloidal layer, expansion pressure, and volatile matter. They also conducted carbonization experiments in semiindustrial [illegible] and industrial coke ovens. As a result of the experiments it was found that the ind[illegible]es of the Laoshihtan coal in such things as thickness of the colloidal layer and strength of single-type coal carbonization were all near Chinghsing coal, and that it is good quality coal. However, the [illegible] coking property, structural strength, and antiabrasive property [illegible] the Inner Mongolian Wutangkou gas coal were all inferior to the [illegible] coal which they had used until then. [illegible] good quality coke be made substituting these coals? They [illegible] difficult problem. According to the until then [illegible], old, [illegible] opinion, Wutangkou coal, Chinghsing coal, and [illegible] not [illegible] interchanged. However, they [illegible]. [illegible] these differences merely characteristics of vari[illegible] coal and are there not also common aspects? [illegible] the result of [illegible] analysis, they discovered that there was a very [illegible] common point in the three kinds of coal, namely, that the amount of colloidal body which they produce does not vary very much. The thickness of the colloidal layer of Chinghsing coal is 21 mm., of Ta[illegible]shan coal [illegible] mm., and of Wutangkou coal 22 mm., and thickness and property of the colloidal layer are principal factors determining the viscosity and coking property of coal. If there is not a great difference in the thickness of the colloidal layers, why cannot good quality coke come from more gas coal and less coke coal? As the result of numerous experiments, they proved that the quality of coke made with [illegible]shan gas coal instead of Chinghsing coke [illegible] better, and that with suitably increasing the Wut[illegible] coal, coke of a definite quality could be carbonized. Moreover, since the volatile matter of Wutangkou coal is high, when Wutangkou coal is combined in quantity, recovery of chemical products (coke byproducts) increases. In this way, the existing restriction that coke coal predominated in combinations of coal used for coke was for the first time broken through.

Grasping the Merits of Various Kinds of Coal not in Isolation but Comprehensively

Without studying characteristics of various kinds of coal in isolation, they studied interactions when several kinds of coal were classified and combined. For example, the volatile matter of gas coal and rich coal is comparatively high, and with the experience until then, it was considered that in cases in which much rich coal was used, much gas coal could not be used, and that if that were not so, quality of the coke would deteriorate. Under the restraint of this technical restriction, it was thought that when rich coal produced in Inner Mongolia was used, not much Inner Mongolian gas coal could be used. Therefore, although the Shihkuaitzu coal mine is near by, since it produces gas coal of inferior coking property, it was not used very much. This time, they specifically analyzed characteristics of the Shihkuaitzu coal and discovered that the thickness of its colloidal body layer is only 12 mm., and that the coking property is bad and the ash content too high. However, the rich coal deposits of the Niaota coal mine are very large and the thickness of the colloidal body layer is generally more than 30 mm. Therefore, they wondered whether if they combined the Shihkuaitzu coal with a large amount of Niaota coal of good viscosity, mutually supplementing merits and demerits, could not good quality coke be carbonzied? After several tens of experiments, and based on the actual situation, they increased the mixture amount of Niaota coal to 25 percent and made the Shihkuaitzu coal about 15 percent. In accordance with that, coke coal was reduced by 20 percent, and good quality coke could be carbonized and the amount of Shihkuaitzu and Niaota coal used increased to more than twice that used before.

Gaining Lessons from Repeated Successes and Failures

They had many vicissitudes of fortune until they attained success. At first, when a group of persons proposed that if weak coking coal produced at Tatung were partially used and at the same time more rich coal and gas coal of Inner Mongolia were combined it would be possible to increase the volatile matter of the coal, shorten the transportation distance of the coal, and decrease the cost of coke, the plant management was dubious. However, it was learned that another plant was mixing Tatung coal, and it developed that if everyone thought it would be extremely beneficial, it would at least be tried, and in the first test, when 5 percent was mixed, coke of very good quality was produced. In the second test, it was made 10 percent, and indeed, coke of good quality was produced. Since, by computation, if a 10 percent combination were continued more than 1,400,000 yuan could be saved per year, and even with 5 percent, more than 700,000 yuan could be saved, the plant leadership was delighted and had self-confidence. However, after two days, since the combination of gas coal from the Shihkuaitzu coal mine was increased, the quality of coke declined. Thereupon, the old technical restriction again raised its head, and since the Tatung coal did not change to coke, they shrunk from the difficulty saying that it was at times good and bad, and therefore useless.

Also, when by means of a series of experiments they proved that Laoshihtan coal is an excellent rich coke coal which is as good as Chinghsing coal, the people were extremely delighted. However, a problem arose in coal washing. That was that the recovery rate of washed coal was very low, being only about 30 percent. Technicians of the plant went to the coal-washing workshop and immediately handed down the decision that Laoshihtan coal is useless coarse coal, and that when three tons of coal are washed, only one ton is obtained, and the cost is too high. However, the majority of the technicians and workers thought that since the cause of the low recovery rate of washed coal was not clear, it was too early to come to the decision that it was a failure, and they decided to summarize their experience and gain lessons. This time, as the result of detailed study which extended over several days, it was learned that there is much crushed powder in Laoshihtan coal, and that when washed with water it is apt to congeal and is at times washed away by the water, which [illegible] the recovery rate. Since the cause was made clear, the leaders and technicians discussed and analyzed it together with the [illegible], and since the operation was improved, the amount of wind and water adjusted, and the congealing problem solved, the recovery rate increased to more than 50 percent, and thus, the evaluation of Laoshihtan coal was changed from bad quality coal to good quality coal.

Seeking the Mixture Ratio and Coke Oven Temperature

Such things occurred many times. At the end of [illegible], by means of more than 200 experiments on iron boxes and large ovens, the restriction that if coke coal was not principally used, good coke could not be made, was fundamentally broken [illegible]

1964 plan for coal use was made, they decided to fundamentally cease use of Chinghsing coke coal and to use 40 percent Inner Mongolian coal. However, later, since the carbonization time was reduced because of the necessity of increased iron and steel production, the quality of the coke again dropped. Encountering a new difficulty, the old restriction which had previously been broken through again raised its head, and it was regretted that indeed coke coal was better and that when there was little of it, it did not go well, and that the ratio of Inner Mongolian coal should not be made high. In order to restore the quality of the coke, they increased the combination ratio of coke coal to 25 percent. However, the quality of the [illegible] did not improve. Upon analysis and research, it was learned that the principal reason the quality of coke dropped was not that the amount of coke coal used was decreased but was because the combination ratio of raw [illegible] coal and the carbonization temperature had not conformed to requ[illegible] shortened carbonization time. When the combination ratio and the temperature of the coke oven were [illegible] and several tens of tests conducted, the quality of coke again [illegible], even though 40 percent Inner Mongolian coal was used and, as before, only 10 percent coke coal was used.

Amount of Inner Mongolian Coal Used Reaches 70 Percent

The ratio of Inner Mongolian coal has gradually increased and has now reached 70 percent, and the amount of coke coal used has decreased to 20 percent. With more than one year of practice, it has been demonstrated that the quality of coke made from Inner Mongolian coal has completely met standards and is suitable for use in blast furnaces. The crush-resisting strength of coke which has most concerned people has increased eight kilograms from before, and various qualities detrimental to iron manufacture have been greatly [illegible] from before, and the recovery rate of byproducts which are used [illegible] the manufacture of agricultural chemicals has increased. [illegible] coke plant of the Paot'ou Iron and Steel Company has come [illegible] locally-produced coal, the average transportation [illegible] has been reduced by more than 200 kilometers, [illegible] portation costs have decreased, coke production [illegible] have [illegible] greatly lowered.

Sixty Percent Gas Coal Used by [illegible]

Since the coke plant of the Paot'ou [illegible] succeeded in carbonization of good-quality coke [illegible] rich coal and gas coal, many coke plants throughout the [illegible] manufacturing good-quality coke with rich coal [illegible] as principal raw materials. For example, the coke plants of the [illegible] Iron and Steel Company and the Taiyuan Iron and Steel Company, together with using rich coal as a principal raw material, are [illegible] mixing weak coking coal which it has heretofore been considered [illegible] not be fundamentally used in coke carbonization. However, [illegible] of the carbonized coke has increased from before, and the ash content is also less than in previous coke. The Wuhan Iron and Steel Company carbonizes coke qualified for use in iron manufacture using 60 percent gas coal of rather high colloidal body (depth of colloidal layer about 18 mm.). The coke plant of the Anshan Iron and Steel Company also uses 50 percent gas coal, and the quality is good, it is suitable for large-sized blast furnaces, and ash content is lower than in previous coke.

This technical accomplishment in combination of coal used for coke has very great significance for the development of China's coke and metallurgical industries. According to rough statistics, if coke is carbonized with rich coal and gas coal as principal raw materials, coal which can be used in coke carbonization, as calculated with deposits which are presently known, will increase twice over previously. If to that is added coal which has not been used in some coke carbonization, the raw material resources of China's coke industry again greatly increase.

Overcoming All-Country Irrationality With New Combination Methods

China's coke industry has for more than the last ten years been completely based on the coal combination theory of foreign countries. Therefore, it has been considered that using the four kinds of coke coal, rich coal, gas coal, and lean coal in carbonization of coke, coke coal must predominate and be made at least more than 30 percent. However, in China, among coke raw material coal which has already been investigated, deposits of gas coal are greatest, and there is comparatively little coke coal. Also, the regional distribution of various kinds of coal is unbalanced. Thus, at many coke plants, [illegible] had to take the long way around and have the raw material coal [illegible] in large quantity from other districts, and throughout the [illegible], the illogical phenomenon has occurred of transporting [illegible] to north and north to south. Thus, transportation [illegible] devoted to this and the cost of coke [illegible]. [illegible] fact is that China's coal resources [illegible].

Bright Future in Resources [illegible]

Since coke has come to [illegible] coal as principal raw materials, [illegible] coal from long distances [illegible] coke plants has changed, [illegible] therefore, trend [illegible] [illegible].

[illegible]

matter ratio of coal and has increased chemical industrial products, and therefore, agricultural and fertilizer production has increased.

At present, in all principal coke plants throughout the country, for example coke plants of the Paot'ou Iron and Steel Company, Shih-chingshan Iron and Steel Company, Chungking Iron and Steel Company, and the Wuhan Iron and Ste Company, have been established coal combination experimentation stations, and they are continuously conducting coke carbonization scientific experiments and creating conditions for further expansion of new kinds of use. This new road which has been opened up in resources of raw material coal used for coke which had become a bottleneck in development of the iron and steel industries will probably henceforth be widened more and more.